GE Energy

The IGCC Option

Challenges to Clean Coal Additions in Western US

DeLome Fair
Product Line Leader, Gasification

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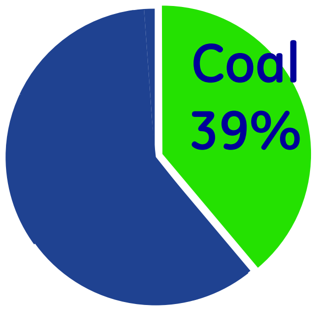
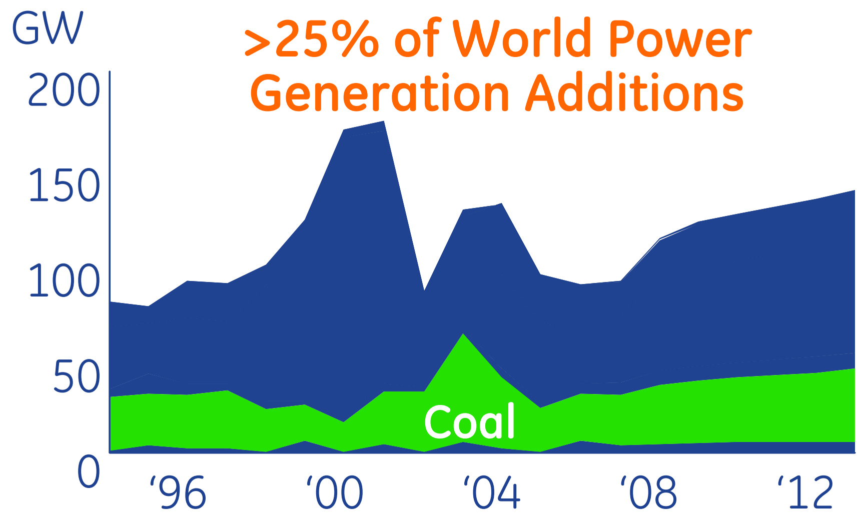
California Energy Commission Workshop
August 17, 2005

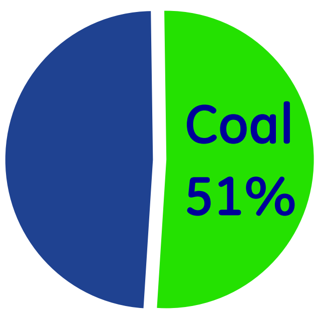
Coal Power Generation and Future Additions

2002 Global Total:
16074 TWhr



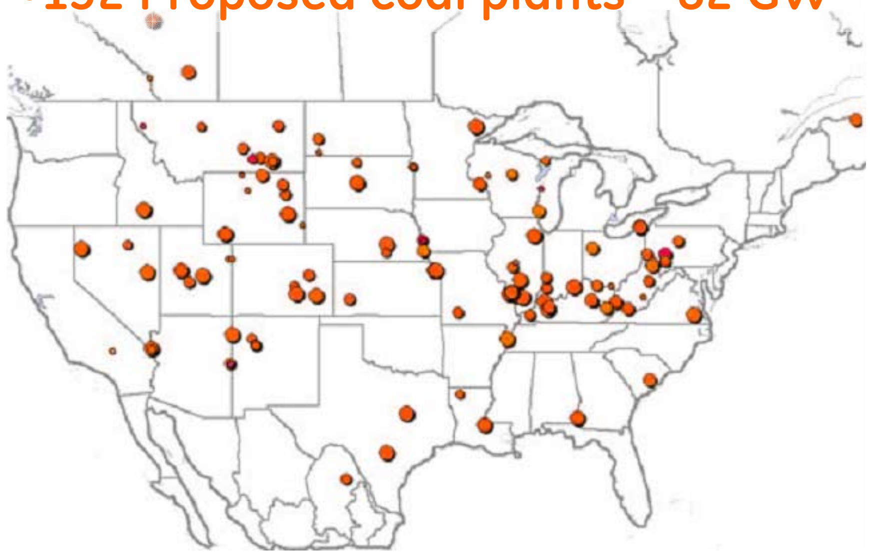


2002 US Total:
4017 TWhr



Source: IEA: World Electricity Generation, 2004

~132 Proposed coal plants – 82 GW



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Power Generation.....Market Challenges

- High/volatile natural gas prices
- Availability of natural gas/LNG
- Aging coal-fired fleet
- Aggregate US demand growth ~2.0% *pa*
- Need for fuel diversity
- **Concerns over energy security**
- **Increasing environmental regulations**
  - **NO_X, SO_2, PM_{10}.....+ Hg**
- **Carbon dioxide capture & management**

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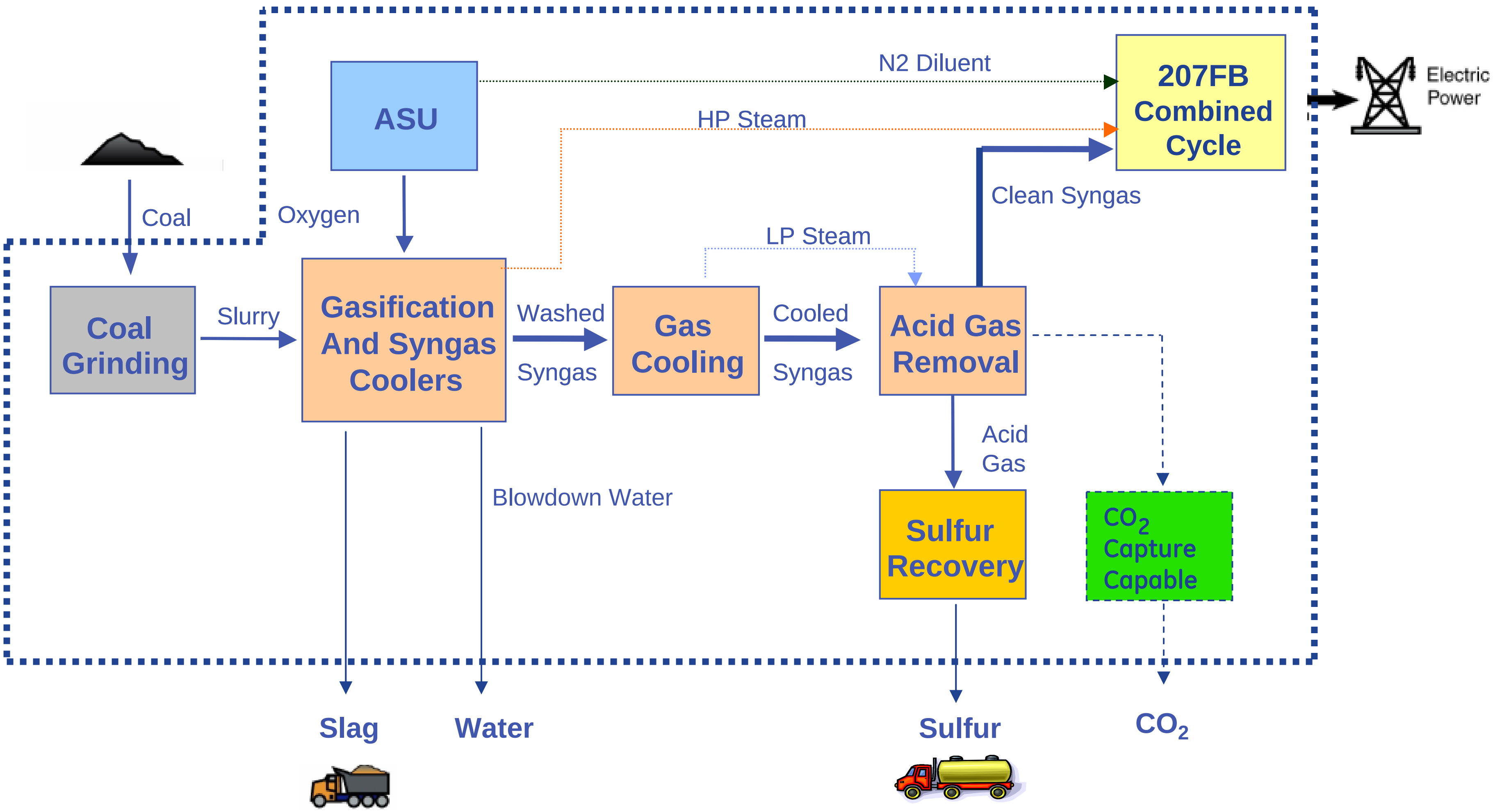
GE/Bechtel's IGCC Reference Plant



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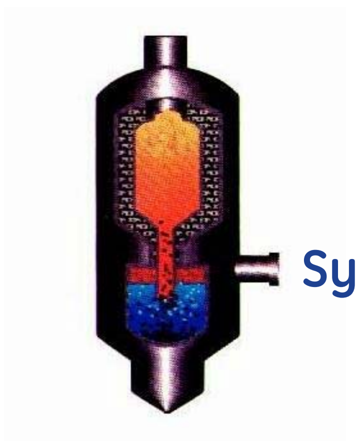
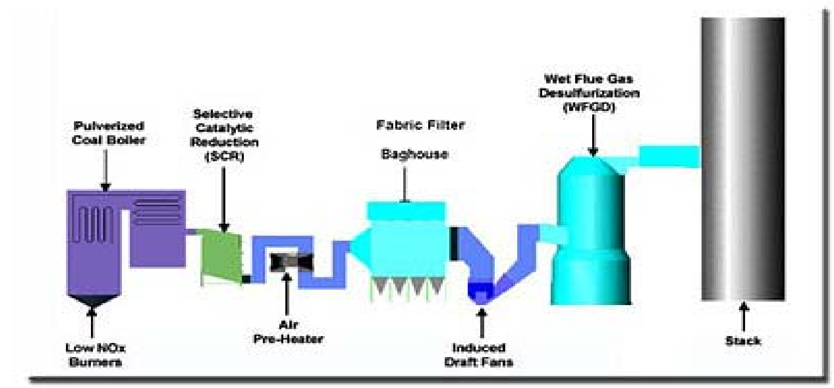
IGCC - Cleaner By Design

Pollution Prevention vs. Pollution Control



Syngas → Cleanup prior to combustion



High Temperature, High Pressure, Reducing Conditions

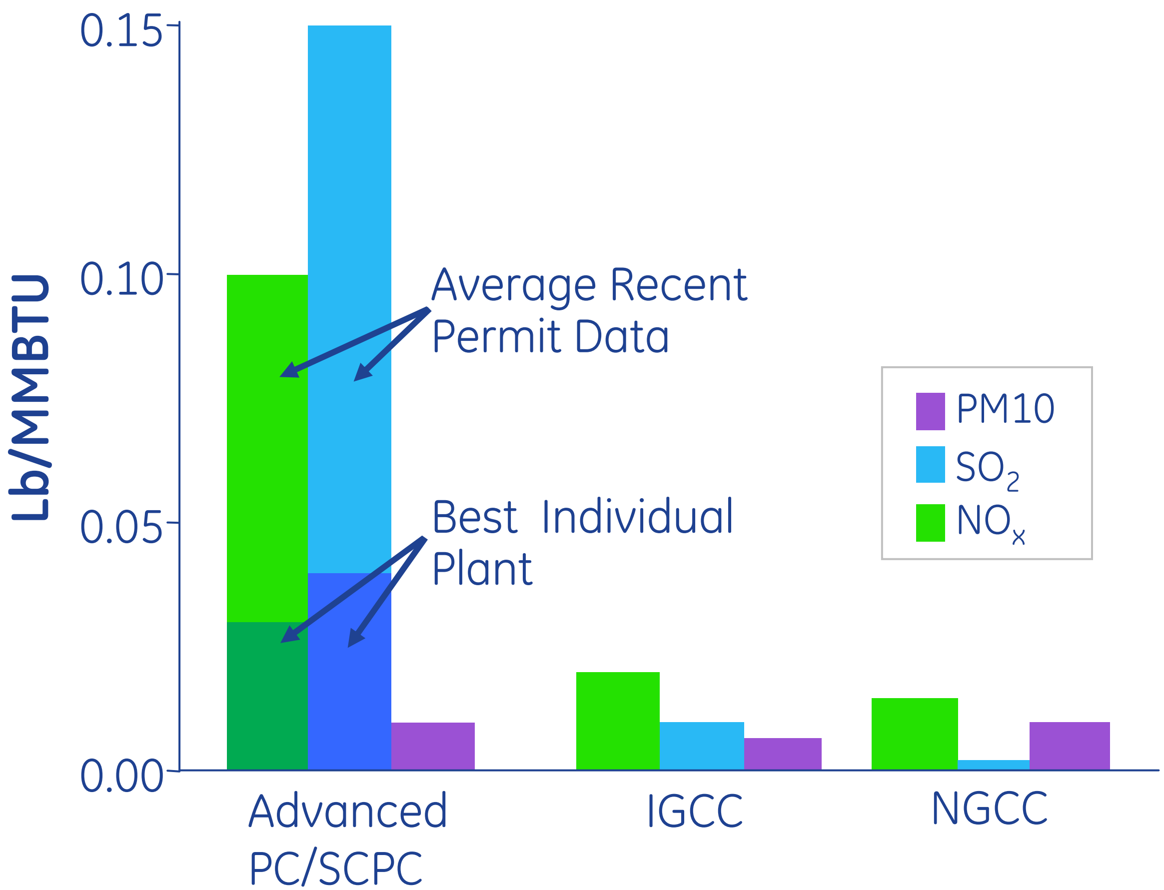
Coal + Water + Oxygen -> Syngas

Minerals -> Vitrified Slag (non-leachable, commercial applications)

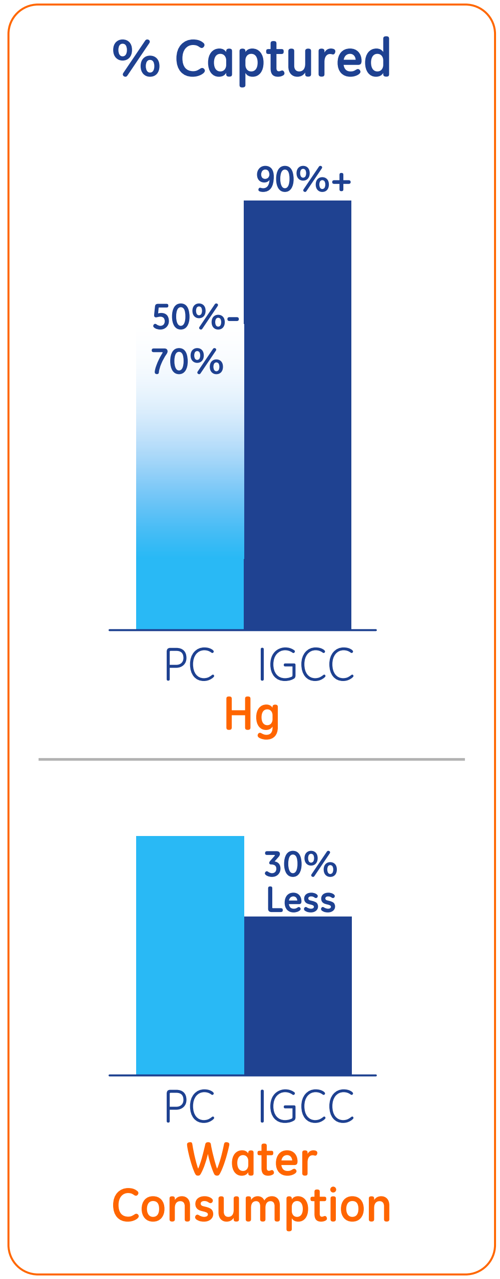
Sulfur Compounds-> Elemental Sulfur, saleable byproduct

Mercury -> Greater Than 90% Removal Rate

Criteria Emission Comparison



Source: GE internal data, average of 28 permits granted, applications and publicly reported emissions



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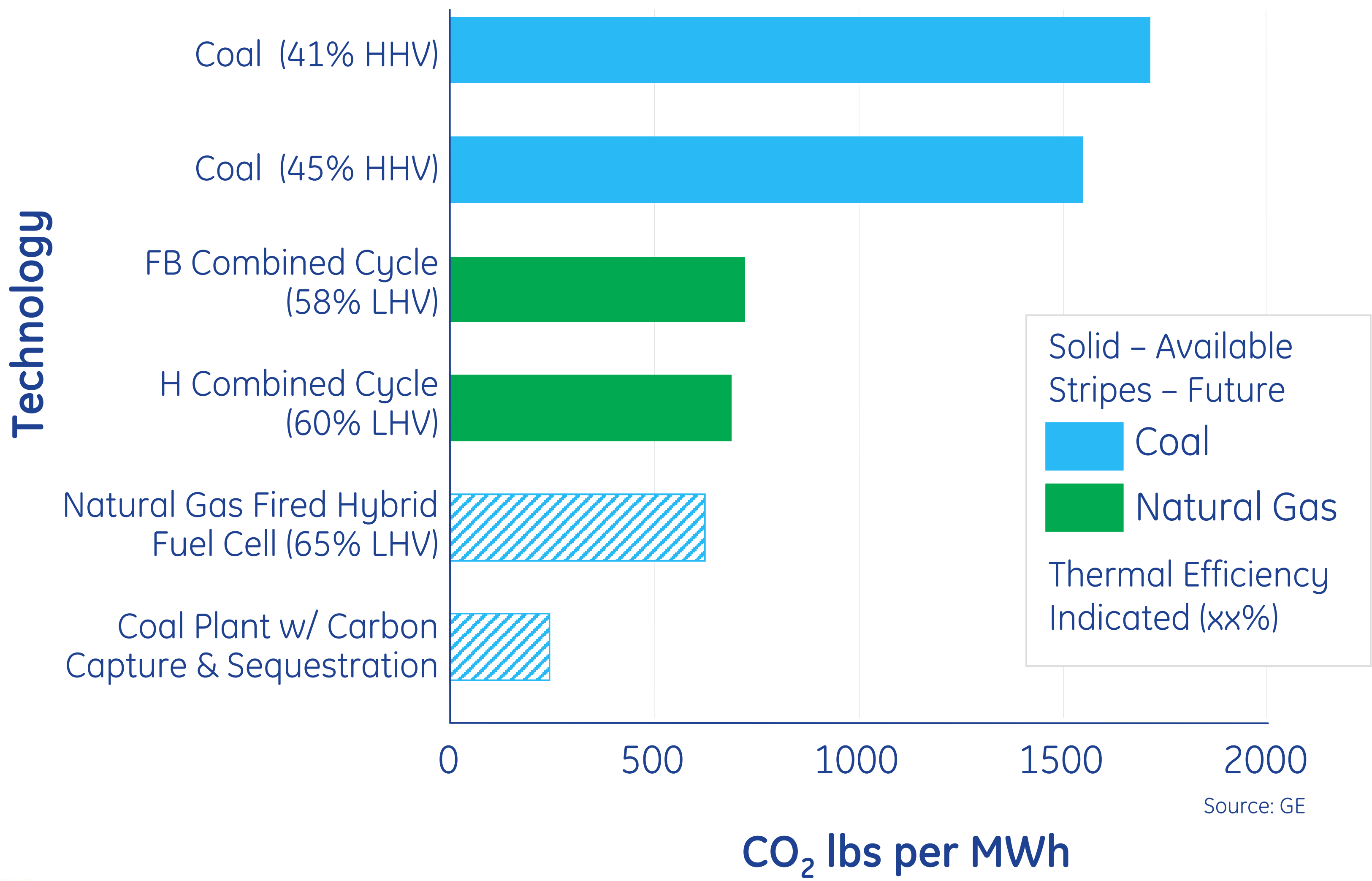
CO_2 Production with Today's Fuels



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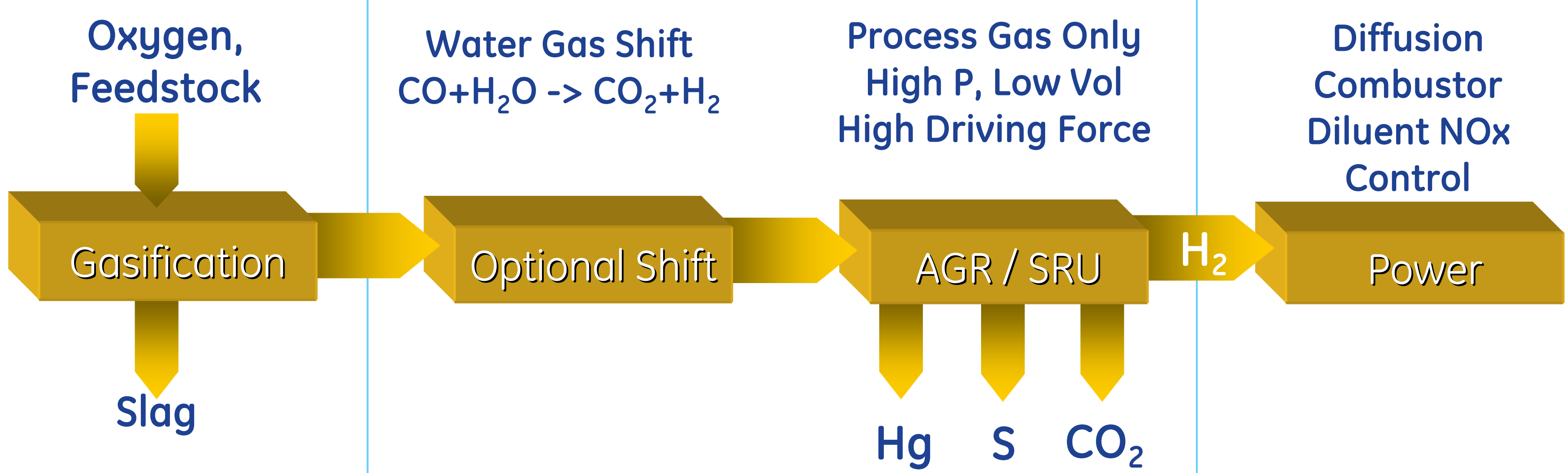
Carbon Dioxide Capture Friendly



Proven Gasification

- 60 GE Licensed Gasification Units operating worldwide – 12 with solid feedstock

Proven Process Technology

- >25 GE Licensed Gasification Units operating worldwide using shift reaction to produce H_2 – 8 with solid feedstock
- >25 GE Licensed Units operating worldwide using AGR technology to completely remove CO_2 from shifted syngas – 8 with solid feedstock

Proven Turbine Capability

- 25 GE Gas Turbines operating at 50%+ H_2
- F-class combustion validation up to 90% H_2

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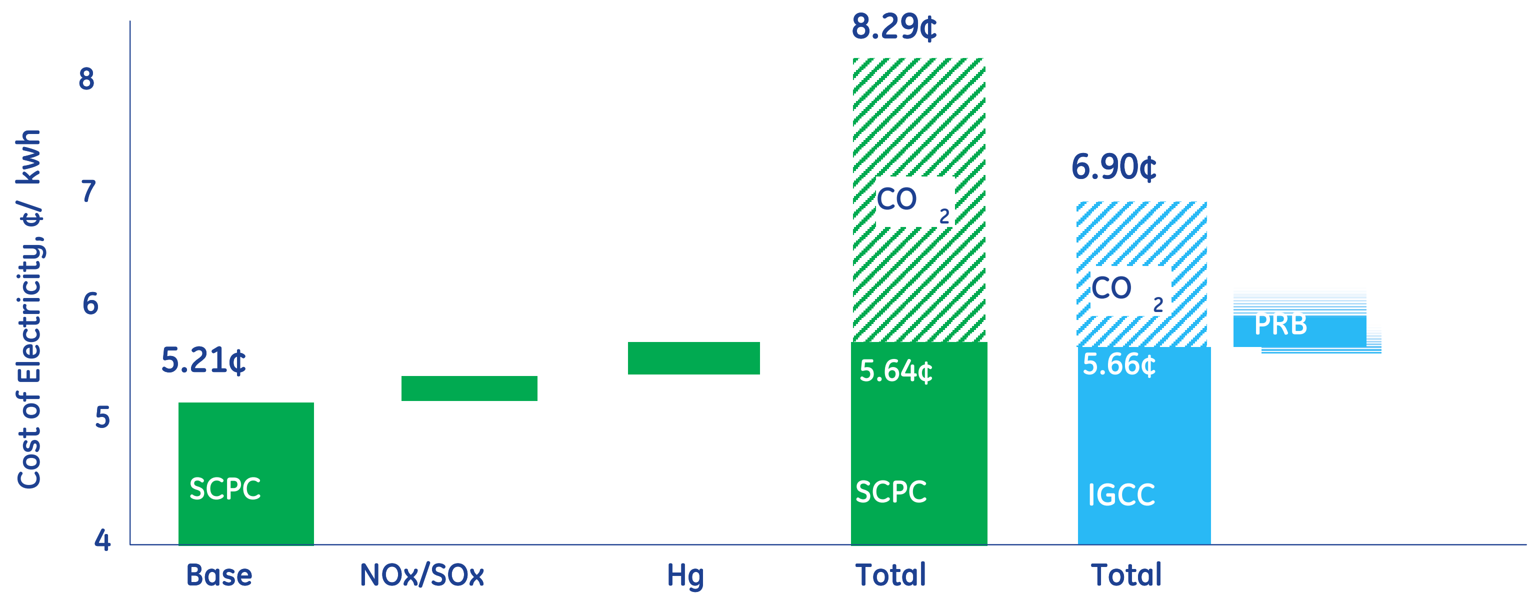
Cost of Electricity Analysis



Basis

Plant output: 600MW

SCPC price: $1425/kW (Greenfield)

IGCC 10% capex premium

First year cost of electricity in 2005

Fuel: IL #6 price $1.75/MMBTU

Availability (SCPC 90%, IGCC 85%)

Emissions: $3500/ton NOx

$750/ton SOx

IGCC is Commercially Viable Technology Today

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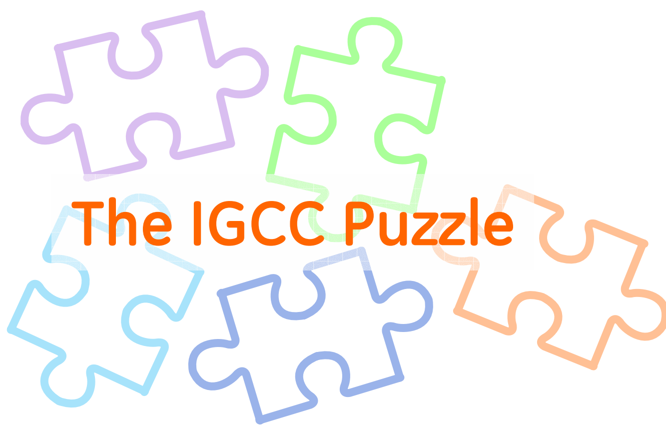
IGCC Commercial Status

Coolwater Prototype	Commercial Demos Polk, Wabash	Competitive IGCC Offerings
120MW	250MW	600MW+
1984	1995	2005



- CAPEX too high (+20%)
- COE too high (+10%)
- Poor Initial RAM
- No system guarantees or warrantees – only license

- Technology consolidation
- Alliances
- Single point offering
- Step increases in product development spending

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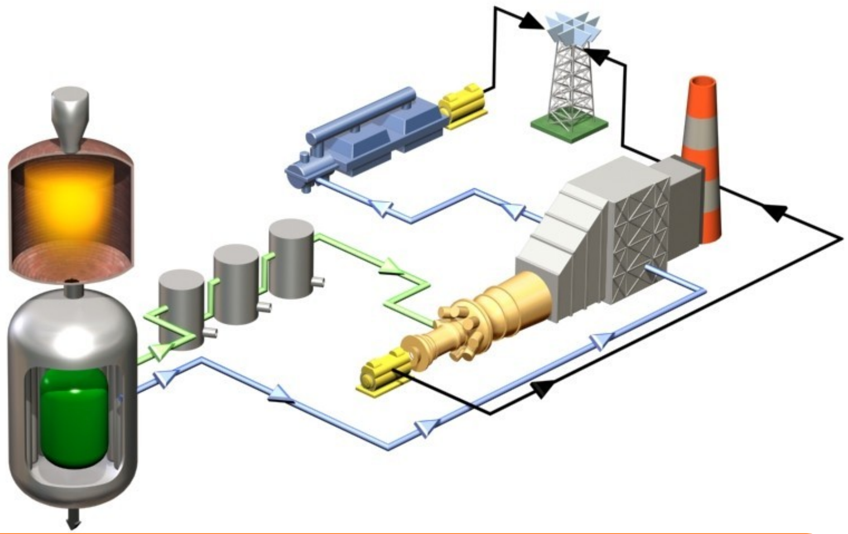
IGCC in Western US



Issues

- Significant portion of New Coal Generation in US Expected to use Western Coals
- Bulk of Gasification solid fed Experience is on Bituminous Coal and Pet Coke
- IGCC is technically feasible on Western coals. Economics are currently unfavorable. Competitive Solutions for Western Coals are needed.
- Combined Cycle Output Decreases with Altitude

Actions

- Short Term – IGCC with PRB/Pet coke blend is ready today
- Long Term – Technology Development for Higher Efficiency Gasification of Low Rank Coals Underway
- Western Coal Demo Plant in Energy Policy Act of 2005 will accelerate commercial demonstration
- Investigating mitigating actions to reduce altitude impact on combined cycle

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GE’s Corporate Commitment to Gasification/IGCC

- Investment in Reference Plant
- Resource hiring (2x)
- Increased development budget by 15x
- Sustained long-term product development
- Technology synergies

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